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**APPEAL BRIEF**  
**Before**  
**Board of Patent Appeals and Interferences**  
**in the**  
**United States Patent & Trademark Office**

In re:

U.S. Serial No: 08/877,684  
Filed: June 17, 1997  
Inventors: George A. Vaughan, Jo Ann M. Canich, Phillip T. Matsunaga,  
David Gindelberger, Timothy D. Shaffer, Kevin R. Squire  
Title: SUPPORTED LATE TRANSITION METAL CATALYST SYSTEMS

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02/03/2006



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**I. REAL PARTY IN INTEREST**

Exxon Chemical Patents, Inc.

**II. RELATED APPEALS AND INTERFERENCES**

No pending appeals or interferences are known to the Applicants.

**III. STATUS OF CLAIMS**

In the Office Action dated March 29, 1999, pending claims 1-5, 13-21, 30 and 32 were rejected. Claim 9 was previously cancelled. Claims 6-8, 10-12, 22-29 and 31 were withdrawn from consideration

The rejection of claims 1-5, 13-21, 30 and 32 is appealed.

**IV. STATUS OF AMENDMENTS**

The amendments requested in the response dated September 28, 1999 were not entered by the Examiner. The claims stand as amended in response to the Office Action dated October 6, 1998.

**V. SUMMARY OF INVENTION**

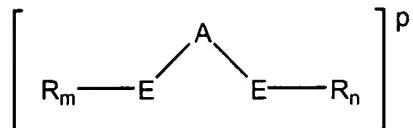
The present invention, as claimed, is directed to a catalyst system comprising a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand immobilized on a solid support. The catalyst system of claim 1 under appeal has a late transition metal loading of less than 100 micromoles transition metal compound per gram of solid support. The catalyst system of claim 13 under appeal is essentially without residual solvent.

**Late Transition Metal Catalyst**

A late transition metal catalyst system is defined in claims 1 and 13 under appeal as comprising an activated Group 9, 10 or 11 transition metal compound stabilized by a bidentate ligand. The Group 9, 10 or 11 transition metal compound stabilized by a bidentate ligand is of the formula:

LMX<sub>r</sub>

where M is a Group 9, 10 or 11 metal; L is a bidentate ligand defined by the formula:



wherein A is a bridging group containing a Group 13-15 element; each E is independently a Group 15 or 16 element bonded to M; each R is independently a C<sub>1</sub>-C<sub>30</sub> containing radical or diradical group which is a hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, hydrocarbyl-substituted organometalloid, halocarbyl-substituted organometalloid, m and n are independently 1 or 2 depending on the valency of E; and p is the charge on the bidentate ligand such that the oxidation state of MX<sub>r</sub> is satisfied;

each X is, independently, a hydride radical, a hydrocarbyl radical, a substituted hydrocarbyl radical, a halocarbyl radical, a substituted halocarbyl radical, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid; or two X's are joined and bound to the metal atom to form a metallacycle ring containing from about 2 to about 20 carbon atoms; a neutral hydrocarbyl containing donor ligand; a halogen, an alkoxide, an aryloxide, an amide, a phosphide, or other univalent anionic ligand; or two X's are joined to form an anionic chelating ligand; or a neutral non-hydrocarbyl atom containing donor ligand; and r is 0, 1, 2 or 3.

The definition for the late transition metal catalyst can be found in the specification on page 2, line 21 to page 3, line 3.

## VI. ISSUES

The issues on appeal are:

- (1) Whether the catalyst system described in claims 1-5, 13-21, 30 and 32 is anticipated, under 35 U.S.C. § 102(b), by Sommazzi et al (US 5,314,856).

- (2) Whether the catalyst system described in claims 1-5, 13-21, 30 and 32 is anticipated, under 35 U.S.C. § 102(e), by Brookhart et al (US 5,866,663).
- (3) Whether the amendments filed on February 8, 1999 introduce new matter under 35 U.S.C. § 132.
- (4) Whether claims 1-5, 13-21, 30 and 32 contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventors had possession of the invention at the time of filing, under 35 U.S.C. § 112, 1<sup>st</sup> paragraph.
- (5) Whether claims 1-5, 13-21, 30 and 32 are indefinite under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph.

## VII. GROUPING OF CLAIMS

Claims 1-5, 13-21, 30 and 32 stand together.

## VIII. ARGUMENTS

### Cited References

The art relied upon in the rejection of the claims under appeal is listed below.

Sommazzi et al	US 5,314,856
Brookhart et al	US 5,866,663

**ARGUMENTS IN RESPONSE TO ISSUE 1**

Issue 1, identified above, is repeated below for the Board's convenience:

(1) Whether the catalyst system described in claims 1-5, 13-21, 30 and 32 is anticipated, under 35 U.S.C. § 102(b), by Sommazzi et al (US 5,314,856).

As stated in MPEP § 2131, "*a claim is anticipated only if each and every element as set forth in a claim is found, either expressly or inherently described, in a single prior art reference.*" *Verdegaal Bros. V. Union Oil Co. of California, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).*" As discussed below, Sommazzi et al does not teach, either expressly or inherently, each and every element set forth in claims 1 and 13 under appeal.

Claims 1-3, 5, 13-15, 30 and 32 were rejected under 35 U.S.C. § 102(b) as being anticipated by Sommazzi et al. The Examiner alleged that "*Sommazzi discloses a silica supported Pd catalyst having a bidentate ligand, the amount of the catalyst on the support reading on present claim 1, the dried catalyst reading on claim 13, and the bridging groups between the two coordinating groups of the bidentate ligand reading on present claim 5.*" The Examiner pointed to col. 3, lines 2-17, col. 4, lines 12-20 and 40-52 and examples 1-3 to support his allegation.

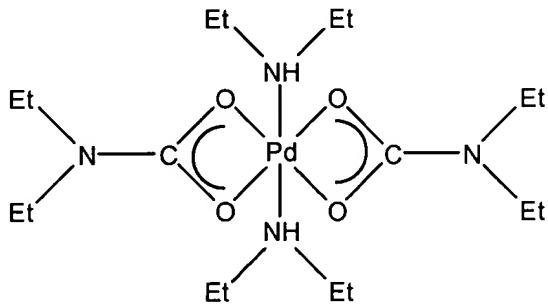
It is respectfully submitted that, for the reasons discussed below, Sommazzi et al does not teach the claimed catalyst system. Accordingly, the rejection under 35 U.S.C. § 102(b) as being anticipated by Sommazzi et al must be withdrawn.

As stated at col. 3, lines 2-17, Sommazzi et al describes a hydroformylation catalyst and process for the production of alternating olefin/carbon monoxide copolymers. The hydroformylation catalyst is constituted by (a) a solid compound produced from the interaction of  $Pd(O_2CNEt_2)_2(NHEt_2)_2$  with a solid carrier, (b) a mono- or bidentate ligand containing one or two nitrogen or phosphorous atoms, capable of binding to the Pd atom through dative

bonds, and (c) a mineral or organic acid, such as trifluoroacetic acid, p-toluene sulfonic acid, sulfuric acid, or alkane sulfonic acids. The ratio of silica:Pd carbamate is 80:20 - 99:1 by weight (col. 4, lines 12-20) and the bidentate ligand is of the formula R<sub>1</sub>R<sub>2</sub>-M-R-M-R<sub>3</sub>R<sub>4</sub> (col. 4, lines 40-52). Examples 1-3 demonstrate preparation of Pd[Pd(O<sub>2</sub>CNEt<sub>2</sub>)<sub>2</sub>(NHEt<sub>2</sub>)<sub>2</sub>] carbamate and a carrier at a loading of 303 micromoles Pd/g and 263 micromoles Pd/g.

*Not yet  
by p/p added  
is not comp.  
Comparison*

First, Sommazzi does not teach the claimed catalyst system. The Applicants believe that the structure for Pd(O<sub>2</sub>CNEt<sub>2</sub>)<sub>2</sub>(NHEt<sub>2</sub>)<sub>2</sub> can be represented as shown below:



However, there is no illustration or discussion in Sommazzi et al of the composition of the metal complex with the ligand attached. There is likewise no discussion in Sommazzi et al of whether any of the groups bonded to the metal center are abstracted to allow for bonding of a bidentate ligand. Accordingly, Sommazzi et al does not anticipate the claimed invention because Sommazzi et al does not teach the claimed catalyst system.

*Naked structure;  
no C-C bonds w/o  
apparent M-C bond.*

*M-C bond...  
not by p/p. Cls.*

Second, it is generally accepted by those skilled in the art that the active center of a catalyst useful for coordination or insertion polymerization of polyolefins must have a metal-carbon bond as a propagating chain unit. As the Board can see by the above structural formula for Sommazzi et al's palladium complex, there is no metal-carbon bond. Furthermore, Sommazzi et al's bidentate ligand is datively bonded to the Pd atom through 2 nitrogen or phosphorus atoms. Accordingly, even when the ligand is bonded to the Pd atom, there is no metal-carbon bond. Moreover, Sommazzi et al does not teach or suggest how to activate their catalyst for polymerization of polyolefins, because their catalyst is for

*Also see 101, 102  
and 103  
MPEP 211.02 recd.  
Structure in recd.  
to give priority  
mentioning such  
structure claim.  
Exs all use CO<sub>2</sub>.*

*AF 1.16*

alternating olefin/carbon monoxide copolymers. It is therefore believed that Sommazzi et al, consistent with the understanding of those skilled in the art, understood that hydroformylation catalyst systems, such as that described in Sommazzi et al, are useful strictly to make alternating olefin/carbon monoxide copolymers. Furthermore, it is generally known to those skilled in the art that catalyst systems, such as that described in Sommazzi et al, do not function in the absence of carbon monoxide.

*No activation in recd. claims*

In the claimed catalyst system of the present application, the X group often provides a metal-carbon bond for a propagating chain unit. However, to the extent that X does not provide a metal-carbon bond, the present application teaches that an activator is used to treat the compound LMX<sub>r</sub> to provide a metal-carbon bond for a propagating chain unit. See, for example, page 2, line 34 to page 3, line 3 and page 4, lines 33-35 of the present application.

Accordingly, the catalyst system of Sommazzi et al does not fall within the scope of the catalyst system recited in the independent claims under appeal. Accordingly, each and every element of claims 1 and 13 under appeal is not found either expressly or inherently described in the Sommazzi et al reference. The rejection of claims 1-3, 5 and 13-15 under 35 U.S.C. § 102 (b) in view of Sommazzi et al should be withdrawn.

## ARGUMENTS IN RESPONSE TO ISSUE 2

Issue 2, identified above, is repeated below for the Board's convenience:

(2) Whether the catalyst system described in claims 1-5, 13-21, 30 and 32 is anticipated, under 35 U.S.C. § 102(e), by Brookhart et al (U.S. Patent No. 5,866,663).

As stated in MPEP § 2131, *"a claim is anticipated only if each and every element as set forth in a claim is found, either expressly or inherently described, in a single prior art reference."* *Verdegaal Bros. V. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). As discussed below, Brookhart et al does not teach, either expressly or inherently, each and every element set forth in claims 1 and 13 under appeal.

Claims 1-5, 13-15, 30 and 32 were rejected under 35 U.S.C. § 102(e) as being anticipated by Brookhart et al (U.S. Patent No. 5,866,663).

The Examiner pointed to the abstract, col. 1-33, col. 38, top, and Example 98 of Brookhart et al in support of his position that *"Brookhart discloses the present invention as claimed"*.

*Ex. 933, 434, col. 2/3*  
*Ex. 98, col. 1/10*  
*col. 51 l. 51-65*

The Applicants reviewed the abstract, col. 1-33 and col. 38, and could not find any reference to a supported catalyst system, as claimed in the present application.

Example 98 of Brookhart et al is a polymerization example, using as a catalyst, silica impregnated *"with a methylene chloride solution of {[(2,6-i-PrPh)<sub>2</sub>DABMe<sub>2</sub>]PdCH<sub>2</sub>CH<sub>2</sub>C(O)CH<sub>3</sub>}SbF<sub>6</sub>" to give a 10 wt % loading of the catalyst on silica.* The 10 wt.% loading of the palladium compound of Brookhart et al is equivalent to a loading of 156 micromoles palladium per gram of silica. This transition metal loading is significantly greater than the transition metal loading of less than 100 micromoles transition metal per gram of solid support recited in claim 1 under appeal.

Accordingly, each and every element of claim 1 under appeal is not found either expressly or inherently described in the Brookhart et al reference. The

rejection of claim 1 and its dependent claims 2-5, 21 and 30 under 35 U.S.C. § 102(e) in view of Brookhart et al should be withdrawn.

*Examiner's  
to dry catalyst  
before use or  
when used in  
pluriblock manner  
e.g. UNIPOL™*

The Applicants reasonably believe that the supported catalyst prepared in Example 98 of Brookhart et al has residual solvent. There is nothing in Example 98 which appears to teach or suggest that the residual solvent was removed from the catalyst prior to polymerization. Claim 13 under appeal recites "a late transition metal catalyst system essentially without residual solvent". This recitation is not taught in the cited passages of the Brookhart et al reference.

Accordingly, the Examiner's rejection of claim 13 and its dependent claims 14-20 and 32 under 35 U.S.C. § 102(e) in view of Brookhart et al should be withdrawn. For the reasons discussed above the Examiner's rejection of claims 1-5, 13-15, 30 and 32 under 35 U.S.C. § 102(e) as being anticipated by Brookhart et al should be withdrawn.

**ARGUMENTS IN RESPONSE TO ISSUE 3**

Issue 3, identified above, is repeated below for the Board's convenience:

(3) Whether the amendments filed on February 8, 1999 introduce new matter under 35 U.S.C. § 132.

The Examiner objected to certain of the amendments filed on February 8, 1999 under 35 U.S.C. § 132 as introducing new matter into the disclosure. Each of the new matter objections raised by the Examiner is traversed for the reasons set forth under separate headings below.

As stated in *In re Oda* (170 USPQ 268, 1971) "*New matter*" is a technical legal term in patent law - a term of art. Its meaning has never been clearly defined for it cannot be. The term is on par with such terms as infringement, obviousness, priority, abandonment, and the like which express ultimate legal conclusions and are in the nature of labels attached to results after they have been reached by processes of reasoning grounded on analyses of factual situations. In other words, the statute gives us no help in determining what is or is not "new matter." We have to decide on a case-by-case basis what changes are prohibited as "new matter" and what changes are not. ...In a sense, anything inserted in a specification that was not there before is new to the specification but that does not necessarily mean it is prohibited as "new matter". Accordingly, the amendments cannot be rejected on a *per se* basis. As stated in *In re Oda*, changes to an application must be decided on a case-by-case basis.

**Deletion of "0"**

The Examiner asserted that the deletion of "0" on page 2, line 33 introduces new matter. In *Ex parte D* (27 USPQ2d 1067, 1993), the Board of Patent Appeals and Interferences held that "a change, *per se*, in an application disclosure does not constitute proscribed new matter. The question that first must be answered is whether the initial application provided by the patentee adequately enabled a person skilled in the subject art to practice the invention as

*claimed.*" Accordingly, the Examiner cannot use *per se* analysis to reject the proposed amendment as new matter, but rather must look at the nature of the requested amendment.

Furthermore, the correction of a structural formula for a chemical compound does not necessarily constitute new matter. In *Ex parte Marsili* (214 USPQ 904, 1979), the Patent and Trademark Office Board of Appeals reversed the Examiner's decision to refuse entry of an amendment to correct an error in the structural formula of a single ring moiety of a complex compound, effectively the difference between an aromatic and a non-aromatic heterocyclic ring structure. The Board held that "*to refuse correction of the structural formula of Appellant's claimed compounds, which have been found patentable by the Examiner, would lead to the absurdity of issuing a patent which teaches the public in its specification the wrong scientific formula for the new products.*"

The amendment requested in the response dated February 8, 1999 was made to correct an error in the numerical definition of a subscript in the general formula of the claimed Group 9, 10 or 11 metal complex. The Applicants noticed the error when reviewing the application prior to filing the response dated February 8, 1999. It is respectfully submitted that the nature of the requested amendment to correct the value of the subscript "r" is of a less serious nature than that of Marsili. Furthermore, it likely would be considered by at least one Board to be absurd to refuse correction of a structural formula of the claimed compounds.

Accordingly, the objection under 35 U.S.C. § 132 of the deletion of "0" in the numerical description of the subscript should be withdrawn.

#### **Deletion of "covalently"**

The Examiner also asserted that the deletion of the word "covalently" on page 3, line 10 introduces new matter. The amendment was introduced in the response dated February 8, 1999 to correct a typographical error. As stated in that response, the structures shown on page 15 illustrate dative bonds between the nitrogen and nickel atoms. While it may be argued that a dative bond, also

referred to as a coordinate covalent bond, could be viewed as a type of covalent bond, the Applicants are concerned that the term "covalently bonded" on page 3, at line 10, may be strictly interpreted as "*a bond in which each atom of a bound pair contributes one electron to form a pair of electrons*" (McGraw-Hill Dictionary of Scientific and Technical Terms, 5<sup>th</sup> edition, pg. 474).

As discussed in more detail below regarding the Examiner's additional rejection of this amendment under 35 U.S.C. § 112, 1<sup>st</sup> paragraph (Response to Issue 4), even though the bonds between the nitrogen and nickel atoms are illustrated with solid single bond lines instead of arrows in the structures illustrated on page 15, it is respectfully submitted that it is clear to a person of ordinary skill in chemistry, that the bonds in the illustrated structures are dative bonds. The nitrogen atoms of the ligand, prior to bonding to the metal, have three N-C bonds and a lone pair of electrons. The lone pair of electrons are thus bonded to the nickel atom in a dative bond. However, the Applicants also contemplated other types of bonds between the E and M elements of the catalyst at the time of filing the application. For example, in some of the possible compositions, one of the elements E of the ligand may be bonded to the metal with a covalent bond, while the other element E is bonded to the metal with a dative bond. The nature of the bond itself is not important, but rather that the ligand stabilizes the metal complex.

Accordingly, the objection under 35 U.S.C. § 132 of the deletion of the word "covalently" should be withdrawn.

#### **Amendment to Abstract**

Finally, the Examiner stated that the February 8, 1999 amendment to the abstract may also be seen as new matter. The Applicants respectfully traverse this objection.

The Board should note that the amendment to the abstract was made in response to the Examiner's request to do so in Paragraph 7 of the Office Action dated October 6, 1998. Specifically, the Examiner had objected to the abstract in the October 6, 1998 Office Action "because the support of the present claims is

not required to contain a metal or metalloid oxide." When the Applicants took out the apparently offensive language, the Examiner then characterized the amendment as being new matter.

It does not appear to be efficient for an Examiner to first request an amendment and then reject the amendment as introducing new matter. Furthermore, the abstract is not intended nor designated for use in interpreting the scope or meaning of the claims (37 C.F.R. § 1.72 (b)). The objection under 35 U.S.C. § 132 of the amendment to the abstract should be withdrawn.

The Applicants have addressed each of the amendments which the Examiner regarded as new matter and have provided sound arguments in support of the amendments. Therefore, the objections under 35 U.S.C. § 132 should be withdrawn.

**ARGUMENTS IN RESPONSE TO ISSUE 4**

Issue 4, identified above, is repeated below for the Board's convenience:

(4) Whether claims 1-5, 13-21, 30 and 32 contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventors had possession of the invention at the time of filing, under 35 U.S.C. § 112, 1<sup>st</sup> paragraph.

The Examiner rejected claims 1-5, 13-21, 30 and 32 under 35 U.S.C. § 112, 1<sup>st</sup> paragraph as "*containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.*"

Specifically, the Examiner stated that the specification as originally filed required a covalent bond between the transition metal of the metal complex and the E atoms of the ligand, on page 3, line 10 and in the exemplary formulas on page 15, Table I. As stated in the response filed February 8, 1999 and discussed above (Response to Issue 3), the word "covalently" was deleted from page 3, line 10 because it was a typographical error. The Applicants were concerned that the word "covalently" would be strictly interpreted as "*a bond in which each atom of a bound pair contributes one electron to form a pair of electrons*" (McGraw-Hill Dictionary of Scientific and Technical Terms, 5<sup>th</sup> edition, pg. 474), as opposed to a dative bond, or coordinate covalent bond, wherein a pair of electrons is contributed by one atom. However, the Applicants were aware at the time that the application was filed, that the bonds between the nitrogen and nickel atoms of the exemplary structures in Table I of page 15 were not covalent bonds according to the above recited definition.

The Applicants indicated in the February 8, 1999 response that support for the amendment deleting "covalently" from the specification could be found in the exemplary structures on page 15, Table I which illustrate dative bonds.

The Examiner rejected this statement, on the basis that a dative bond is typically illustrated by an arrow from the atom donating electrons to the atoms receiving the electrons. The Applicants agree with the Examiner that dative bonds are often illustrated with arrows. However, dative bonds are not always illustrated with arrows.

For example, the Board will note that the dative bonds between the nitrogen and nickel atoms of the structures in cols. 5-8, for example, of U.S. 5,866,663 (Brookhart et al) are represented by solid single bond lines.

The Applicants attach in Appendix C a copy of pages 110-111 of General Chemistry Principles and Structure (Brady, J.E. and Humiston, G.E., John Wiley & Sons, 1978), which provides a discussion of dative bonds. The Board's attention is directed to the discussion above the fourth structure on page 111, which indicates that it is more accurate to use a solid single bond line to illustrate the dative bond between the two atoms.

Accordingly, there is no basis for the Examiner's rejection that, because the Applicants did not use an arrow to depict the dative bond, the Applicants did not have possession of the invention at the time of filing.

It is therefore respectfully submitted that it would be clear to a person of ordinary skill in the art that the bonds between the nitrogen and nickel atoms in the structures in Table I on page 15 are dative bonds based on known coordination chemistry and the description of the ligand. In the ligand of the structures, the nitrogen atom is covalently bonded to two carbon atoms to produce three N-C bonds. The nitrogen atoms of the ligand thus have a lone pair of electrons available for bonding to the nickel atoms. Accordingly, the Applicants reasonably believe that the bonds between the nitrogen and nickel atoms are dative in the exemplary structures illustrated in Table I of page 15.

Moreover, the Examiner stated that "*For instance, the actual formulas in table I could have been some sort of Zwitterionic structures, or the entire formulas could have been some sort of ionic species.*" Therefore, it appears that the Examiner is concurring with the Applicants that the bonds between the nitrogen and nickel atoms in the exemplary structures of Table I are not covalent.

Accordingly, the Applicants should not be limited to covalent bonds between the elements E and M. Nevertheless, it is respectfully submitted that it would be very clear to a person of ordinary skill in the art that the exemplary structures of Table I are not zwitterionic structures and that the entire formulas are not some sort of ionic species.

Moreover, it is unreasonable for the Examiner to expect a characterization of each bond in the claimed catalyst system. The Applicants recite in the independent claims that the bidentate ligand stabilizes the metal complex. Accordingly, the bond between E and M stabilizes the metal complex, no matter what the nature of the bond.

The Applicants have also noted that the Examiner did agree, elsewhere in the Office Action dated March 29, 1999, that the term "bonded" is appropriate for the interaction between E and M. The Board's attention is directed to the Examiner's suggestion for amendment to claims 1 and 13 to overcome his rejection under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph, at lines 1-3 of page 5 of the Office Action dated March 29, 1999. The Examiner suggested that, instead of using the word "stabilized", the words "*-- bonded to -- be used instead since the entire entity is a molecule*". The rejection of the word "stabilized" is addressed in more detail below. However, it must be noted that in one part of the Office Action, the Examiner suggested that the word "bonded" is descriptive of the interaction between the ligand and metal complex. The Board will note that the ligand stabilizes the metal complex by bidentate bonding of E to M. Accordingly, it would appear that the Examiner did not agree that the independent claims should recite that "each E is independently a Group 15 or 16 element bonded to M".

The Examiner further asserted that "*It is not clear from the specification what the intended correction was to be*", citing *In re Oda* for support. The Examiner is thus limiting the Applicants to covalent bonds between the E and M elements on the basis that there was one instance of the term "covalently bonded" in the specification as originally filed. The Examiner ignored the fact that the exemplary structures of Table I do not depict covalent bonds, as strictly defined above, to a person of ordinary skill in the art. Furthermore, the independent

claims, as originally filed, required that the metal complex be "stabilized by a bidentate ligand". It would be apparent to a person of ordinary skill in the art that the term "stabilized by a bidentate ligand" inherently means that there are at least two bond(s) between the ligand and metal complex. It is therefore unreasonable for the Examiner to require that the nature of the bond between elements E and M when the claim recites a metal complex stabilized by a bidentate ligand.

*In re Oda* cites *Quigley v. Zimmerman* (22 CCPA 713, 73 F.2d 499, 23 USPQ 310, 314 (1934)), stating "*That amendments may be made to patent applications for the purpose of curing defects, obvious to one skilled in the art, in the drawings or written descriptions of inventions, is so well settled that we deem it unnecessary to cite authorities in support thereof.*" It is respectfully submitted that, for the reasons stated above, the error in inadvertently limiting the bond between elements E and M in one instance on page 3, line 10 to only covalent bonds would be obvious to one skilled in the art.

Accordingly, for all of the reasons discussed above and because the Examiner himself suggested that the word "bonded" is appropriate for the interaction between the ligand and metal complex, the rejection under 35 U.S.C. § 112, 1<sup>st</sup> paragraph should be withdrawn.

## ARGUMENTS IN RESPONSE TO ISSUE 5

Issue 5, identified above, is repeated below for the Board's convenience:

(5) Whether claims 1-5, 13-21, 30 and 32 are indefinite under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph.

The Examiner rejected claims 1-5, 13-21, 30 and 32 under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph as being indefinite. Each of the terms rejected by the Examiner is discussed below under separate headings.

As indicated below, the Applicants proposed amendments to overcome the Examiner's rejections in the response dated September 28, 1999. However, the Examiner did not enter the amendments. For the Board's convenience, the claims including the September 28, 1999 amendments are provided in Appendix B.

### **"For polymerization of olefin monomers"**

The Examiner asserted that the recitation of "for polymerization of olefin monomers" in the preamble of claims 1 and 13 carries no patentable weight.

However, as indicated in MPEP § 2111.02, an amendment to a preamble must be looked at on a case-by-case basis. *"Whether a preamble stating the purpose and context of the invention constitutes a limitation of the claimed process is determined on the facts of each case in light of the overall form of the claim, and the invention as described in the specification and illuminated in the prosecution history"* (Applied Materials Inc. v. Advanced Semiconductor Materials America, Inc., 98 F.3d 1563, 1573, 40 USPQ2d 1481, 1488 (Fed. Cir. 1996)).

The amendment to the preamble to recite the intended use was made to more clearly distinguish over the cited art, specifically the Sommazzi et al reference, discussed above. As further stated in MPEP § 2111.02, *"in apparatus, article, and composition claims, intended use must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art."* As discussed more fully

under Issue 1, there is a structural difference between the claimed catalyst system and that of the cited Sommazzi et al reference which is more clearly distinguished in the amendment to the preamble.

Accordingly, the rejection of the preamble under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph should be withdrawn.

#### "Stabilized"

The Examiner alleged that it is not clear what the Group 9, 10 or 11 metal complex is "stabilized" against. The Applicants intended the word "stabilized" to mean that the Group 9, 10 or 11 metal complex is stabilized against decomposition, including reduction to metal and/or dimerization. It is respectfully submitted that it would be clear to a person of ordinary skill in the art, reading the phrase "*a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand*", that the bidentate ligand stabilizes the complex against decomposition.

For the Board's convenience, the Applicants attach in Appendix D a copy of page 1899 of the 5<sup>th</sup> Edition of the McGraw-Hill Dictionary of Scientific and Technical Terms which defines stability as "*the property of a chemical compound which is not readily decomposed and does not react with other compounds*". However, it is clear that the catalyst must still be reactive, by the use of the word "catalyst" and the disclosed utility for polymerization of olefin monomers. It is therefore respectfully submitted that a person of ordinary skill in the art would understand that the bidentate ligand stabilizes the metal complex against decomposition.

The Examiner has suggested that the word "stabilized" be replaced with the words --bonded to--. However, this would change the meaning intended by the Applicants in this portion of the claim. The Applicants do indicate, later in claims 1 and 13, that the bidentate ligand is bonded to the Group 9, 10 or 11 metal through element E of the ligand.

Accordingly, for the reasons discussed above, the rejection of claims 1 and 13, under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph, in the use of the word "stabilized" should be withdrawn.

**Antecedent basis for "the Group 9, 10 or 11 metal complex"**

The Examiner rejected the preambles of claims 1 and 13 because the phrase "*the Group 9, 10 or 11 metal complex*" strictly lacks antecedent basis. Specifically, the Examiner suggested that the phrase before the formula be amended to read "*the Group 9, 10 or 11 metal complex stabilized by a bidentate ligand*". Though the Applicants believe that the phrase "*the Group 9, 10 or 11 metal complex*" is clear, the Applicants attempted to amend the claims in accordance with the Examiner's request. However, the Examiner did not enter the amendment made on September 28, 1999.

*Applicants*

It is believed that the phrase "*the Group 9, 10 or 11 metal complex*" is clear and, therefore, the rejection under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph, should be withdrawn. However, the Applicants are willing to amend claims 1 and 13 as proposed in the response dated September 28, 1999, should the Board deem the amendment appropriate.

**"Oxidation state of MX<sub>r</sub> is satisfied"**

The Examiner rejected the phrase "*the oxidation state of MX<sub>r</sub> is satisfied*" at the end of the recitation of the identity of the L group of claims 1 and 13 because it is not clear in view of claims 17 and 21. The Examiner queried whether the term means that the oxidation state of the entire LMX<sub>r</sub> molecule is neutral. The Examiner is correct that the oxidation state of the entire LMX<sub>r</sub> is neutral. However, the Applicants do not agree that this meaning would "*conflict with the recitations of claims 17 and 21, in which the metal-containing species is a cation*".

*Ox state means neutral  
M° state; class to  
rec'd.*

Page 2, line 21, as originally filed, states that the polymerization catalysts of the present invention can be derived from late transition metal compounds of the formula LMX<sub>r</sub>.

The Applicants attempted to amend claims 17 and 21 to clarify the original intent of the claims in the response dated September 28, 1999, to more clearly indicate that the catalyst complex has been treated with a noncoordinating

anion precursor to form an ionic catalyst comprising a metal cation and a noncoordinating anion. However, the Examiner did not enter the amendment.

The Applicants proposed that claims 17 and 21 recite that the LMX<sub>r</sub> complex has been treated with a noncoordinating anion precursor to form an ionic catalyst comprising a metal cation and a noncoordinating anion. Support for the proposed amendments to claims 17 and 21 can be found on page 4, line 33 to page 5, line 9, page 6, lines 11-25 and page 7, lines 18-19. Claims 17 and 21 illustrate preferred methods of treating late transition metal compounds with an activator.

The Applicants are willing to make the clarifying amendment to claims 17 and 21, as proposed in the response dated September 28, 1999, to overcome the rejections of claims 1, 13, 17 and 21.

#### **"Hydrocarbyl containing"**

The Examiner requested the insertion of a hyphen between the words "hydrocarbyl" and "containing" in the fifth line from the end of both independent claims.

The Applicants proposed amendments to claims 1 and 13, as requested by the Examiner. However, the amendments were not entered by the Examiner.

*Amp' reread*  
The Applicants are willing to make the clarifying amendment to claims 1 and 13, as proposed in the response dated September 28, 1999, to overcome the rejections of claims 1 and 13.

#### **"Or other univalent anionic ligand"**

The Examiner asserted that "or other univalent anionic ligand" is omnibus, vague and indefinite in the fourth line from the end of claims 1 and 13. The Applicants proposed to amend claims 1 and 13 to recite "a univalent anionic ligand" as a possible X group in the response filed September 28, 1999 on the basis that examples of univalent anionic ligands, namely a halogen, an alkoxide, an amide and a phosphide, were disclosed on page 2, at line 38, of the application as originally filed. The Applicants stated that other suitable univalent anionic

*already claimed  
won't be problem*

ligands would be readily apparent to a person of ordinary skill in the art upon reviewing the list of example univalent anionic ligands.

However, the Examiner did not enter the amendment on the basis that deleting particular species of X broadens the protection sought and would require further consideration and search. The Applicants disagree with the Examiner in that the option of other univalent anionic ligands was present in the claims when the Examiner conducted his search. The relevance of the patents attached to the Advisory Action to this issue is not understood.

The Applicants are willing to make the clarifying amendment to claims 1 and 13, as proposed in the response dated September 28, 1999, to overcome the rejections of claims 1 and 13.

#### **"Square planar geometry"**

The Examiner rejected claims 30 and 32 because it is not clear about what entity the "square planar geometry" is "stabilized". The Applicants proposed amendments to claims 30 and 32 in the response dated September 28, 1999 to indicate that LMX<sub>r</sub> has a square planar geometry. However, the Examiner did not enter the amendment.

The Applicants are willing to make the clarifying amendment to claims 30 and 32, as proposed in the response dated September 28, 1999, to overcome the rejections of claims 30 and 32.

#### **"Anion precursor"**

The Examiner indicated that he was still not clear what is meant by "anion precursor" in claim 19. Accordingly, Applicants proposed a clarifying amendment to claim 19, in the response dated September 28, 1999, to clarify that the precursor is a noncoordinating anion precursor. The term "noncoordinating anion precursor" is defined on page 6 at lines 11-25, as originally filed. However, the Examiner did not enter the amendment.

The Applicants are willing to make the clarifying amendment to claim 19, as proposed in the response dated September 28, 1999, to overcome the rejection of claim 19.

The Applicants have addressed each of the terms rejected by the Examiner under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph, and have provided amendments and/or arguments in support of the terms. The rejections under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph should be withdrawn.

### Conclusion

For the reasons discussed above with respect to Issues 1-5, it is respectfully submitted that the rejections under §102(b), §102(e), §112, 1<sup>st</sup> paragraph and §112, 2<sup>nd</sup> paragraph should be withdrawn.

Respectfully submitted,



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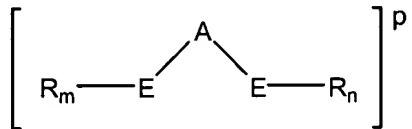
## IX. APPENDIX A

Claims 1-5, 13-21, 30 and 32, involved in the appeal, are listed below.

1. A late transition metal catalyst system for polymerization of olefin monomers comprising a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand immobilized on a solid support where the late transition metal loading is less than 100 micromoles transition metal compound per gram of solid support, the Group 9, 10 or 11 metal complex of the formula:



wherein M is a Group 9, 10 or 11 metal; L is a bidentate ligand defined by the formula:



wherein A is a bridging group containing a Group 13-15 element; each E is independently a Group 15 or 16 element bonded to M; each R is independently a C<sub>1</sub>-C<sub>30</sub> containing radical or diradical group which is a hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, hydrocarbyl-substituted organometalloid, halocarbyl-substituted organometalloid, m and n are independently 1 or 2 depending on the valency of E; and p is the charge on the bidentate ligand such that the oxidation state of MX<sub>r</sub> is satisfied;

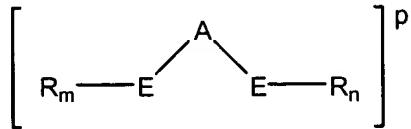
each X is, independently, a hydride radical, a hydrocarbyl radical, a substituted hydrocarbyl radical, a halocarbyl radical, a substituted halocarbyl radical, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid; or two X's are joined and bound to the metal atom to form a metallacycle ring containing from about 2 to about 20 carbon atoms; a neutral hydrocarbyl containing donor ligand; a halogen, an alkoxide, an aryloxide, an amide, a phosphide, or other univalent

anionic ligand; or two X's are joined to form an anionic chelating ligand; or a neutral non-hydrocarbyl atom containing donor ligand; and r is 1, 2 or 3.

2. The catalyst system of claim 1 wherein said solid support comprises silica.
3. The catalyst system of claim 1 wherein the metal complex immobilized on the solid support is a homogeneous supported catalyst.
4. The catalyst system of claim 1 wherein the metal complex is a first row metal complex.
5. The catalyst system of claim 1 wherein the bridging group has a conjugated group.
13. A late transition metal catalyst system essentially without residual solvent for polymerization of olefin monomers comprising a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand immobilized on a solid support, the Group 9, 10 or 11 metal complex of the formula:



wherein M is a Group 9, 10 or 11 metal; L is a bidentate ligand defined by the formula:



wherein A is a bridging group containing a Group 13-15 element; each E is independently a Group 15 or 16 element bonded to M; each R is independently a C<sub>1</sub>-C<sub>30</sub> containing radical or diradical group which is a hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, hydrocarbyl-substituted organometalloid,

halocarbyl-substituted organometalloid, m and n are independently 1 or 2 depending on the valency of E; and p is the charge on the bidentate ligand such that the oxidation state of MX<sub>r</sub> is satisfied;

each X is, independently, a hydride radical, a hydrocarbyl radical, a substituted hydrocarbyl radical, a halocarbyl radical, a substituted halocarbyl radical, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid; or two X's are joined and bound to the metal atom to form a metallacycle ring containing from about 2 to about 20 carbon atoms; a neutral hydrocarbyl containing donor ligand; a halogen, an alkoxide, an aryloxide, an amide, a phosphide, or other univalent anionic ligand; or two X's are joined to form an anionic chelating ligand; or a neutral non-hydrocarbyl atom containing donor ligand; and r is 1, 2 or 3.

14. The catalyst system of claim 13 wherein said solid support comprises silica.
15. The catalyst system of claim 13 wherein the metal complex immobilized on the solid support is a homogeneous supported catalyst.
16. The catalyst system of claim 13 wherein the metal complex is a first row metal complex.
17. The catalyst system of claim 13 wherein said complex is an ionic catalyst comprising a metal cation and a noncoordinating anion.
18. The catalyst system of claim 17 wherein the noncoordinating anion is tetrakis(perfluorophenyl)borate.
19. The catalyst system on claim 17 wherein the ionic catalyst is prepared using an anion precursor that is a halide salt of Group 13-16 metals or metalloids.

20. The catalyst system of claim 19 wherein the metal complex to anion precursor molar ratio is from about 10:1 to 1:10.
21. The catalyst system of claim 1 wherein said complex is an ionic catalyst comprising a metal cation and a noncoordinating anion
30. The catalyst system of claim 1 wherein the bidentate ligand stabilizes a square planar geometry.
32. The catalyst system of claim 13 wherein the bidentate ligand stabilizes a square planar geometry.

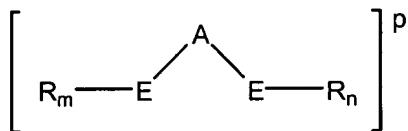
## X. APPENDIX B

Claims 1-5, 13-21, 30 and 32, including amendments requested in the response dated September 28, 1999 but not entered by the Examiner, are listed below.

1. A late transition metal catalyst system for polymerization of olefin monomers comprising a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand immobilized on a solid support where the late transition metal loading is less than 100 micromoles transition metal compound per gram of solid support, the Group 9, 10 or 11 metal complex stabilized by a bidentate ligand of the formula:



wherein M is a Group 9, 10 or 11 metal; L is a bidentate ligand defined by the formula:



wherein A is a bridging group containing a Group 13-15 element; each E is independently a Group 15 or 16 element bonded to M; each R is independently a C<sub>1</sub>-C<sub>30</sub> containing radical or diradical group which is a hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, hydrocarbyl-substituted organometalloid, halocarbyl-substituted organometalloid, m and n are independently 1 or 2 depending on the valency of E; and p is the charge on the bidentate ligand such that the oxidation state of MX<sub>r</sub> is satisfied;

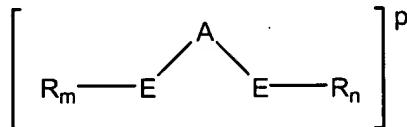
each X is, independently, a hydride radical, a hydrocarbyl radical, a substituted hydrocarbyl radical, a halocarbyl radical, a substituted halocarbyl radical, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid; or two X's are joined and bound to the metal atom to form a metallacycle ring containing from about 2 to about 20 carbon atoms; a neutral hydrocarbyl-containing donor ligand; a [halogen, an alkoxide, an aryloxide, an amide, a phosphide, or other] univalent

anionic ligand; or two X's are joined to form an anionic chelating ligand; or a neutral non-hydrocarbyl atom containing donor ligand; and r is 1, 2 or 3.

2. The catalyst system of claim 1 wherein said solid support comprises silica.
3. The catalyst system of claim 1 wherein the metal complex immobilized on the solid support is a homogeneous supported catalyst.
4. The catalyst system of claim 1 wherein the metal complex is a first row metal complex.
5. The catalyst system of claim 1 wherein the bridging group has a conjugated group.
13. A late transition metal catalyst system essentially without residual solvent for polymerization of olefin monomers comprising a Group 9, 10 or 11 metal complex stabilized by a bidentate ligand immobilized on a solid support, the Group 9, 10 or 11 metal complex stabilized by a bidentate ligand of the formula:



wherein M is a Group 9, 10 or 11 metal; L is a bidentate ligand defined by the formula:



wherein A is a bridging group containing a Group 13-15 element; each E is independently a Group 15 or 16 element bonded to M; each R is independently a C<sub>1</sub>-C<sub>30</sub> containing radical or diradical group which is a hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, hydrocarbyl-substituted organometalloid,

halocarbyl-substituted organometalloid, m and n are independently 1 or 2 depending on the valency of E; and p is the charge on the bidentate ligand such that the oxidation state of MX<sub>r</sub> is satisfied;

each X is, independently, a hydride radical, a hydrocarbyl radical, a substituted hydrocarbyl radical, a halocarbyl radical, a substituted halocarbyl radical, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid; or two X's are joined and bound to the metal atom to form a metallacycle ring containing from about 2 to about 20 carbon atoms; a neutral hydrocarbyl-containing donor ligand; a [halogen, an alkoxide, an aryloxide, an amide, a phosphide, or other] univalent anionic ligand; or two X's are joined to form an anionic chelating ligand; or a neutral non-hydrocarbyl atom containing donor ligand; and r is 1, 2 or 3.

14. The catalyst system of claim 13 wherein said solid support comprises silica.
15. The catalyst system of claim 13 wherein the metal complex immobilized on the solid support is a homogeneous supported catalyst.
16. The catalyst system of claim 13 wherein the metal complex is a first row metal complex.
17. The catalyst system of claim 13 wherein said complex [is] has been treated with a noncoordinating anion precursor to form an ionic catalyst comprising a metal cation and a noncoordinating anion.
18. The catalyst system of claim 17 wherein the noncoordinating anion is tetrakis(perfluorophenyl)borate.

19. The catalyst system on claim 17 wherein the [ionic catalyst is prepared using an] noncoordinating anion precursor [that] is a halide salt of Group 13-16 metals or metalloids.
20. The catalyst system of claim 19 wherein the metal complex to noncoordinating anion precursor molar ratio is from about 10:1 to 1:10.
21. The catalyst system of claim 1 wherein said complex [is] has been treated with a noncoordinating anion precursor to form an ionic catalyst comprising a metal cation and a noncoordinating anion
30. The catalyst system of claim 1 wherein [the bidentate ligand stabilizes] LMX<sub>r</sub> has a square planar geometry.
32. The catalyst system of claim 13 wherein [the bidentate ligand stabilizes] LMX<sub>r</sub> has a square planar geometry.

**XI. APPENDIX C**

**Copy of pages 110-111 of General Chemistry Principles and Structure  
(Brady, J.E. and Humiston, G.E., John Wiley & Sons, 1978)**

• GENERAL •  
**CHEMISTRY**  
PRINCIPLES  
AND  
STRUCTURE

JAMES E. BRADY

St. John's University

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Harcum Junior College

JOHN WILEY & SONS

New York Santa Barbara Chichester Brisbane Toronto

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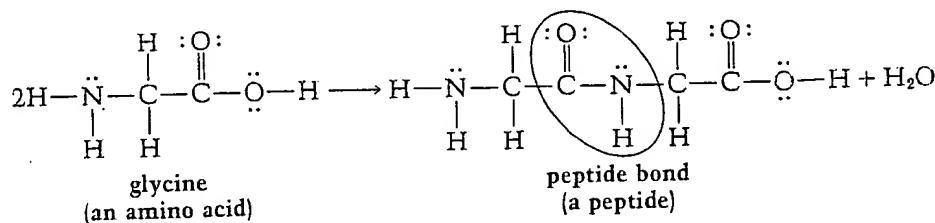
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ISBN 0-471-01910-0

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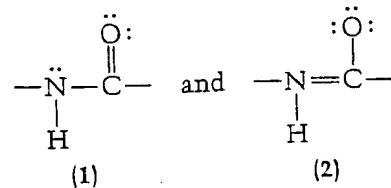
10 9 8 7 6 5 4 3 2 1

ence. For example, the nitrate ion,  $\text{NO}_3^-$ , and the carbonate ion,  $\text{CO}_3^{2-}$ , have the same number of valence electrons, 24, and therefore have similar resonance structures.

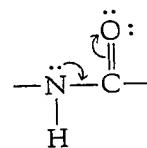
Resonance is certainly not restricted to inorganic compounds. In proteins, for example, amino acids are linked together in long chains by "peptide bonds."



There is evidence that the C—N bond in the peptide linkage actually lies somewhere between a single bond and a double bond. To explain this it is suggested that the peptide bond is a resonance hybrid of structures such as

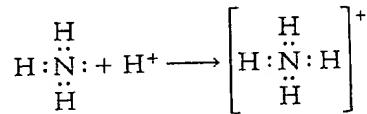


Structure 2 is obtained by rearranging the electrons in structure 1 in this way:



## 4.6 COORDINATE COVALENT BONDS

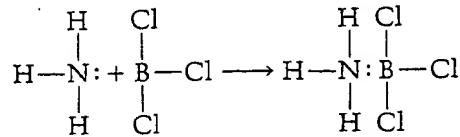
When a nitrogen atom combines with three hydrogen atoms to form the molecule  $\text{NH}_3$ , the N atom has completed its octet. We might expect, therefore, that the maximum number of covalent bonds that we would observe an N atom to form is three. There are instances, however, where N may have more than three covalent bonds. In the ammonium ion,  $\text{NH}_4^+$ , which is formed in the reaction



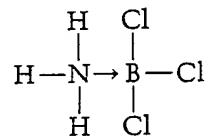
the nitrogen is covalently bound to four hydrogen atoms. When the additional bond between the  $H^+$  and the N atom is created, both of the electrons in the bond come from the nitrogen. *This type of bond, where a pair of electrons from one atom is shared by two atoms, is called either a coordinate covalent bond, or a dative bond.* It is important that you remember that the

Coordinate covalent bond is really no different once formed, than any other covalent bond and that our distinction is primarily aimed at keeping track of electrons; that is, it is "bookkeeping."

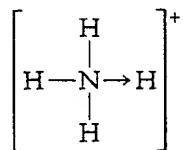
When Lewis structures are written using dashes to represent electron pairs, the coordinate covalent bond is sometimes indicated by means of an arrow pointing away from the atom supplying the electron pair. For example, the product of the reaction of boron trichloride,  $\text{BCl}_3$ , and ammonia,  $\text{NH}_3$ , is a substance known as an addition compound (because it is formed by the simple addition of two molecules).



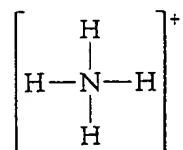
To show that the electron pair shared between the B and N originates on the nitrogen, the Lewis structure of this addition compound can be written



Using this type of notation we are tempted to write the structure of the  $\text{NH}_4^+$  ion as



This gives the impression that one of the N—H bonds is different from the other three. It has been shown experimentally, however, that all four N—H bonds are identical. Therefore, to avoid conveying false impressions, the  $\text{NH}_4^+$  ion is written simply as



#### 4.7 BOND ORDER AND SOME BOND PROPERTIES

The term **bond order** refers to the number of covalent bonds that exist between a pair of atoms. For example, the carbon–carbon bond order in acetylene,  $\text{C}_2\text{H}_2$ , is 3; in ethylene,  $\text{C}_2\text{H}_4$ , it is 2; and in ethane,  $\text{C}_2\text{H}_6$ , it is 1. Fractional bond orders are also possible, as in the case of  $\text{SO}_2$ . Each SO bond in the two resonance structures we draw for  $\text{SO}_2$  is shown as a single bond in one structure and a double bond in the other. As we might expect, the bond order in sulfur dioxide is intermediate between 1 and 2.

The concept of bond order arises as a result of our description of the bonding in covalent molecules. Since we cannot view electrons directly, we

**XII. APPENDIX D**

**Copy of page 1899 of the 5<sup>th</sup> Edition of the McGraw-Hill Dictionary of Scientific and Technical Terms**

A  
E

# McGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS

## Fifth Edition

Sybil P. Parker

Editor in Chief

McGraw-Hill, Inc.

New York      San Francisco      Washington, D.C.  
Auckland      Bogotá      Caracas      Lisbon      London      Madrid      Mexico City      Milan  
Montreal      New Delhi      San Juan      Singapore      Sydney      Tokyo      Toronto

ing between it and a similar roller. { 'skwēz }

[ELECTROMAG] Length of waveguide containing alteration of the critical dimension is possible corresponding alteration in the electrical length. [ECHAN]

[MATERIALS] In resistance welding, the time between application of the current and of the pressure.

blocking oscillator. { 'skwēg·ər }

[ELECTR] Condition of self-blocking in an oscillator circuit. { 'skwēg·inj }

oscillator See blocking oscillator. { 'skwēg·inj ,əs· }

[ELECTR] To automatically quiet a receiver by reducing response to a specified characteristic of the signal.

[ELEC] noise suppressor. { 'skwelch ,sər·kət }

A small tube filled with fine-grained black powder. Igniting and burning of the ignition match, the rocket effect and darts back into the hole to trigger charge. [ORD] A small explosive device, attached to a detonator, but loaded with low explosive output is primarily heat (flash); usually electrically provided to initiate action of pyrotechnic rocket propellants. { skwib }

[INV ZOO] Any of a number of marine cephalopod characterized by a reduced internal shell, ten tentacles, and chromatophores. { skwid }

superconducting quantum interference device.

[INV ZOO] The single family of the eumalacostranomopoda, the mantis shrimp. { 'skwil·ə,dē }

[MECH] A small arch across the interior corner of a support a superimposed mass such as a dome or known as squinch arch. { skwinch }

See squinch. { 'skwinch ,ärch }

[ELECTROMAG] 1. The angle between the two major radar lobe-switching antenna. 2. The angular between the axis of radar antenna radiation and a metric axis, such as the axis of the reflector. 3. Between the full-right and full-left positions of the conical-scan radar antenna. [MED] See strabismus.

[VERT ZOO] Any of over 200 species of arboreal families Sciuridae and Anomaluridae having a long, strong hind limbs. { 'skwərl }

squirrel motor [ELEC] An induction motor in which circuit consists of a squirrel-cage winding arbor in the iron core. { 'skwərl ,kāj ,mōd·ər }

rotor See squirrel-cage winding. { 'skwərl ,kāj }

squigging [ELEC] A permanently short-circuited usually uninsulated, around the periphery of the rotor by continuous end rings. Also known as squirrel. { 'skwərl ,kāj ,wīnd·ɪŋ }

[ENG] An oil can with a flexible bottom and a outlet; pressure applied to the bottom forces oil out the

skwert ,kan }

[ENG] A device with a bulb and nozzle; when the liquid squirts from the nozzle. { 'skwart ,gən }

See compaction. { 'skwish·inj }

[ELECTR] Random firing, intentional or otherwise, of a ponder transmitter in the absence of interrogation.

skymount

short-range attack missile. { 'es,ram }

[ENG] One of a series of sizes to which untrimmed manufactured; for reels of paper the standard sizes are 900, and 1280 millimeters; for sheets of paper the SRA0, 900 × 1280 millimeters; SRA1, 640 × 900

mm, and SRA2, 450 × 640 millimeters; SRA sizes refer to A sizes when trimmed. { 'es,är'ā ,siz }

skid response chain.

skidrol [MATER] A viscous, unfiltered lubrication oil, made from reduced petroleum crudes that have had lubricant fractions removed by direct steam heating;

used to lubricate steam engine cylinders and valves. Also known as steam-refined cylinder oil. { 'es,är'sil·ən·dər ,öil }

SRMS See structure resonance modulation spectroscopy.

SRS See Sonobuoy Reference System.

SS See stainless steel.

SS 433 [ASTRON] A stellar object that shows evidence of ejection of two narrow streams of cool gas travelling in opposite direction from a cool object at a velocity of almost one-quarter the speed of light; the beams execute a repeating, rotating pattern about the central object once every 164 days. { ,es,es ,fōr,thārd·ē'thrē }

SSB See single-sideband.

SS Cygni stars See U Geminorum stars. { 'es,es 'sig·nē ,stārz }

SSD See steady-state distribution.

SSI See small-scale integration.

ss loran See sky-wave-synchronized loran. { 'es,es 'lōr,an }

SSM See surface-to-surface missile.

SSP See static spontaneous potential.

SSR See solid-state relay.

SST See supersonic transport.

S star [ASTRON] A spectral classification of stars, comprising red stars with surface temperature of about 2200 K; prominent in the spectra is zirconium oxide. { 'es ,stār }

s-state [QUANT MECH] A single-particle state whose orbital angular momentum quantum number is zero. { 'es ,stāt }

SSTV See slow-scan television.

SSU See Saybolt Seconds Universal.

St See stoke.

stab [ENG] In a drilling operation, to insert the threaded end of a pipe joint into the collar of the joint already placed in the hole and to rotate it slowly to engage the threads before screwing up. { stab }

stab culture [MICROBIO] A culture of anaerobic bacteria made by piercing a solid agar medium in a test tube with an inoculating needle covered with the bacterial inoculum. { 'stāb,kəl·cher }

stabilator [AERO ENG] A one-piece horizontal tail that is swept back and movable; movement is controlled by motion of the pilot's control stick; usually used in supersonic aircraft. { 'stā·bə,lātər }

stability [CHEM] The property of a chemical compound which is not readily decomposed and does not react with other compounds. [CONT SYS] The property of a system for which any bounded input signal results in a bounded output signal. [ENG] The property of a body, as an aircraft, rocket, or ship, to maintain its attitude or to resist displacement, and, if displaced, to develop forces and moments tending to restore the original condition.

[FL MECH] The resistance to overturning or sinking in the water column, resulting from the presence of a positive (increasing downward) density gradient. [GEOL] 1. The resistance of a structure, spoil heap, or clay bank to sliding, overturning, or collapsing. 2. Chemical durability, resistance to weathering.

[MATER] Of a fuel, the capability to retain its characteristics in an adverse environment, for example, extreme temperature.

[MATH] Stability theory of systems of differential equations deals with those solution functions possessing some particular property that still maintain the property after a perturbation.

[MECH] See dynamic stability. [PHYS] 1. The property of a system which does not undergo any change without the application of an external agency. 2. The property of a system in which any departure from an equilibrium state gives rise to forces or influences which tend to return the system to equilibrium.

Also known as static stability. [PL PHYS] The property of a plasma which maintains its shape against externally applied forces (usually pressure of magnetic fields) and whose constituents can pass through confining fields only by diffusion of individual particles. { 'stā·bil·ədē }

stability augmentation system [AERO ENG] Automatic control devices which supplement a pilot's manipulation of the aircraft controls and are used to modify inherent aircraft handling qualities. Abbreviated SAS. Also known as stability augmentors. { 'stā·bil·ədē ög·mən·tāshən ,sistəm }

stability augmentors See stability augmentation system. { 'stā·bil·ədē 'ög·mən·tərəs }

stability chart [METEOROL] A synoptic chart that shows the distribution of a stability index. { 'stā·bil·ədē ,chārt }

stability constant [CHEM] Refers to the equilibrium reaction of a metal cation and a ligand to form a chelating mononuclear complex; the absolute-stability constant is expressed by the pro-

### SQUID



Dorsal view of a squid (*Loligo*).

U  
V

W  
Z